

# Tensor analyzing power $A_{yy}$ in deuteron inclusive breakup at large $P_t$ and spin structure of deuteron at short internucleonic distances.<sup>1, 2</sup>

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## Abstract

The  $A_{yy}$  data for deuteron inclusive breakup off hydrogen and carbon at a deuteron momentum of 9.0 GeV/c and large  $p_T$  of emitted protons are presented. The large values of  $A_{yy}$  independent of the target mass reflect the sensitivity of the data to the deuteron spin structure. The data obtained at fixed  $x$  and plotted versus  $P_t$  clearly demonstrate the dependence of the deuteron spin structure at short internucleonic distances on two variables. The data are compared with the calculations using Paris, CD-Bonn and Karmanov's deuteron wave functions.

## 1 Introduction

The interest to the  $(d, p)$  reaction at relativistic energies is mostly due to the possibility to observe the manifestation of the non-nucleonic degrees of freedom and relativistic effects in the simplest bounded system.

Large amount of the polarization data in deuteron breakup obtained at a zero degree last years can be interpreted from the point of view  $NN^*$  configurations in the deuteron, where relativistic effects are taken into account by the minimal relativization scheme with the dependence of the deuteron structure on single variable  $k$ . In addition the considering of multiple scattering is required to obtain the agreement with the data[1].

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On the other hand, it was shown that  $T_{20}$  data for the pion-free deuteron breakup process  $dp \rightarrow ppn$  in the kinematical region close to that of backward elastic  $dp$  scattering depended on the incident deuteron momentum in addition to  $k$  [2]. The recent measurements of the tensor analyzing power  $A_{yy}$  of deuteron inclusive breakup on nuclear targets [3, 4, 5] have demonstrated a significant dependence on the transverse secondary proton momentum  $p_T$  being plotted at a fixed value of the longitudinal proton momentum. This forces one to suggest that description of this quantity requires an additional independent variable, aside from  $k$ .

In this report the angular dependence of  $A_{yy}$  in deuteron inclusive breakup on hydrogen and carbon at 9 GeV/c are presented. The results are compared with the relativistic calculations using Paris, CD-Bonn and Karmanov's deuteron wave functions (DWFs).

## 2 Experiment

The experiment has been performed using a tensorially polarized deuteron beam of the Dubna Synchrophasotron and the SPHERE setup described elsewhere [3, 4]. The tensor polarization of the beam has been measured from the asymmetry of protons from the deuteron breakup on nuclear targets,  $d + A \rightarrow p + X$ , at a zero angle and the momenta  $p_p \sim 2/3p_d$  [6]. The vector polarization of the beam has been measured from the asymmetry of quasi-elastic  $pp$  scattering on  $CH_2$  target [7]. The tensor and vector polarizations,  $p_{zz}$  and  $p_z$ , were  $p_{zz}^+ = 0.798 \pm 0.002(stat) \pm 0.040(sys)$ ,  $p_{zz}^- = -0.803 \pm 0.002(stat) \pm 0.040(sys)$ ,  $p_z^+ = 0.275 \pm 0.016(stat) \pm 0.014(sys)$  and  $p_z^- = 0.287 \pm 0.016(stat) \pm 0.014(sys)$ , respectively.

A slowly extracted deuteron beam with a typical intensity of  $\sim 5 \cdot 10^8 \div 10^9$   $\vec{d}/spill$  was directed onto a liquid hydrogen target of 30 cm length or onto carbon targets with varied length. The data at 9 GeV/c of the deuteron initial momentum were obtained at secondary proton emission angles of 85, 130 and 160 mr and proton momenta between 4.5 and 7.0 GeV/c on hydrogen and carbon. The separation of the protons and inelastically scattered deuterons was done by the measurements of their time-of-flight (TOF) over a base line of  $\sim 34$  m. The residual background was completely eliminated by the requirement that particles are detected at least in two prompt TOF windows.

### 3 Results and discussion

The results on  $A_{yy}$  versus the momentum of the secondary protons are presented in Fig. 1 by the solid and open symbols for carbon and hydrogen targets, respectively. The circles are the data of this experiment, while the triangles represent the data obtained earlier[3]. The dashed, dash-dotted and solid lines are the relativistic calculations using Paris[8], CD-Bonn[9] and Karmanov[10] DWFs.

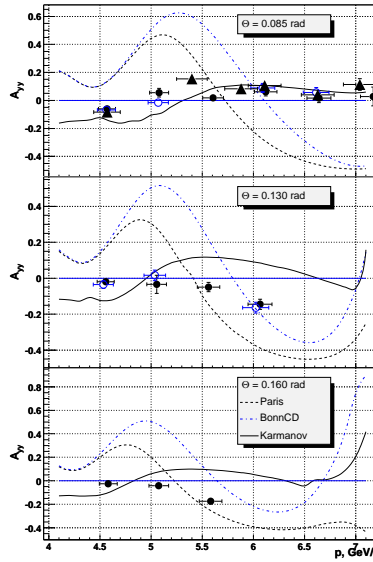


Figure 1: The  $A_{yy}$  data plotted versus secondary proton momentum. The curves are the relativistic calculations with different DWFs.

The data obtained on hydrogen and carbon are in good agreement. Hence multiple scattering processes play a minor role and the obtained information reflects the internal deuteron structure.

The calculations performed in the framework of the light-front dynamics [11] with the use of Paris and CD-Bonn DWFs fail to reproduce the  $A_{yy}$  data, while the use of Karmanov DWF depending on two internal variables,  $k$  and  $p_T$ , is in a reasonable agreement with the data obtained at 85 mr.

$A_{yy}$  data obtained at fixed proton momenta of 6.0, 6.5 and 7.0 GeV/c are plotted versus transverse proton momenta  $p_T$ . The symbols and curves are the same as in Fig.1. Again the use of DWF depending on two variables[10] gives better agreement with the data.

To summarize, the observed features of the  $A_{yy}$  data suggest that the deuteron structure function at short distances, where relativistic effects are significant, depends on more than one variable.

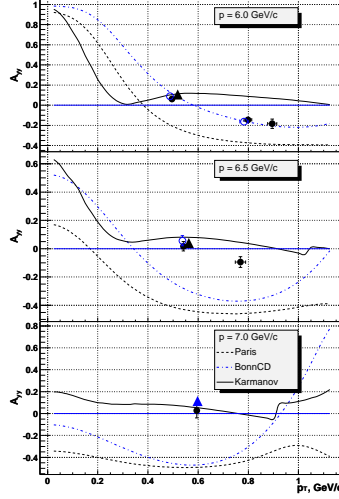


Figure 2: The  $A_{yy}$  data obtained at fixed proton momenta in lab. and plotted versus transverse proton momentum  $p_T$ .

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